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ABSTRACT

The paper outlines the operative principles for understanding learning and discusses how these principles can help in planning a functional program for a severely or profoundly brain-damaged child. Discussed are: (1) the role of memory in learning; (2) simple associative learning (Pavlovian Conditioning and Operant Conditioning); (3) Piaget's concept of the moderate novelty principle, also called a mis-match of expectations; (4) the orienting response or reflex; (5) habituation, which allows the nervous system to focus on relevant events and not be overwhelmed by trivial types of stimulation; (6) the role of the emotions in learning and memory via the limbic system; and (7) procedural memory or habit memory which enables individuals to perform a series of automatically executed motoric behaviors through a non-cognitive kind of behavior. Implications for teaching include stopping stimulus bombardment, giving anticipatory cues and waiting for a response, using routine objects/people in daily events, designing a routine with predictable pleasurable events, and looking for preferences and intentional communication. Includes 20 references. (JDD)

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AN INFORMAL PAPER: TEACHING THE PROFOUNDLY HANDICAPPED CHILD

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November 1, 1989

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AN INFORMAL PAPER: TEACHING THE PROFOUNDLY HANDICAPPED CHILD

by Ann Silverrain

Children who are severely and profoundly brain damaged present those who are responsible for their educational progress both challenges and frustrations. **The purpose** of this informal discussion is:

* to give you some of the operative principles for understanding learning and

* to discuss how these principles can help you plan a functional program for a severely or profoundly brain damaged child.

In working with profoundly involved children, my basic goals are:

* to create an environment in which the child can enjoy life in positive ways, and respond to a variety of pleasurable events; and

* to enable the child's communication with people.

In our zeal to develop nifty cause-and-effect toys/gadgets, we should keep sight of the fact that a child needs to communicate with us rather than with objects.

Generally, the ideas I have pulled together are not what you would find in one particular field of study, and are not found in many of the developmental checklists which we use to help guide us in the education of children with profound handicaps. Checklists can help us at first, but we need a much broader picture in order to ask the right questions that guide our educational programming. The ideas presented are drawn from psychology, infant learning studies, brain research, Piaget, and animal studies.

ASPECTS OF LEARNING AND MEMORY

Any type of learning (in animals, invertebrates, or humans) has to do with memory. Memory has three aspects:

* perceiving something and encoding it (attaching meaning to a stimulus so that it can be remembered)

* storage in either short term or long term memory, and

* retrieving the memory and using it to act to change some aspect of the environment (includes affecting other peoples' actions).

Learning is a process whereby we make and remember associations between one situation and another.

What do we know about learning at the very earliest stages in humans? Newborn studies can give us some basic information about undamaged nervous systems. The brain of a newborn who is neurologically intact,

with its capacity for memory storage, is already starting to function in the first few days of life.

SIMPLE ASSOCIATIVE LEARNING
Or, The Latest In Snail Education

* Pavlovian Conditioning

Before talking about infants, however, I would first like to talk about dogs and snails, as examples of the simplest type of associative learning called classical conditioning or Pavlovian conditioning. You may recall a behavioral result called a conditioned response. Mr. Pavlov would ring a buzzer right before he fed his dog. At first the buzzer had no meaning to the dog. However, the sight and smell of the food would make his dog automatically salivate. After enough pairings of the buzzer with the food, the dog began to salivate when he heard just the buzzer though the food was nowhere in sight. Thus, salivation was made to occur through conditioning to a stimulus (auditory in this case) which had no original meaning to the dog. The dog associated the bell with eating, and anticipated the food at a very non-voluntary level, since he salivated automatically at the sound of the bell.

Snails, believe it or not, demonstrate simple associative learning, and have also been trained to respond to a conditioned stimulus. Recent studies show the effects of learning on the nervous systems of snails. Large groups of sea snails are given a fast spin (simulating the roll of a wave) which makes them contract. Each spin is preceded by a burst of bright light. Bursts of bright light alone have no effect on snails. After a while, the snails will contract when the light is shone on them, as if a spin were imminent. Researchers have shown that during this learning, new nerve connections have grown that did not exist before. The snails began to react or anticipate the spin simply by association with the burst of light. (Wilson Quarterly 1985) (Alkon 1989) (Hooper 1986).

Lest any of you are considering leaving the teaching profession to go work with responsive snails, you might find it interesting to know that newborn human infants have also shown the ability to associate a preceding event with one that follows, such as hearing a bell and turning to either the right or left for their nipple. As we all know, even a hungry, crying baby will become quiet when she hears her parents footsteps approaching in the night because she anticipates the bottle. So we know that the human nervous system is capable of making associations between two events when the final event in the chain relates to basic survival or pleasure needs. (The same principle operates when infants withdraw from human contact after abusive trauma, in that they associate pain with people--and they withdraw from the source of that pain.)

*** Operant Conditioning**

Operant conditioning (as opposed to Pavlovian conditioning) involves a living organism's ability to associate events, but is based on behaviors being rewarded. The animal associates a particular set of behaviors with a certain reward. Behaviors that are rewarded are repeated. In fact, whole chains of behavior can be produced by a method called chaining in which the reward is given at the end of a series of behaviors. My family had a dog who so loved to go on walks that he would get his leash off the doorknob, drop it at our feet, and wait expectantly (for the reward of a walk). This operant behavior on his part came about naturally, as he put two and two together. All animal trainers use operant conditioning to get their animals to perform a series of tricks. The animal associates a signal from the trainer with the chained series of behaviors, at the end of which a tasty morsel awaits. In my case, I perform tricks all month, in a series of chained behaviors, at the end of which a paycheck awaits.

My dog, who brought his leash to me, and my cat who brings his string to me in anticipation of play, are communicating to me at a level that is indeed quite high when we consider the degree of handicaps in some of our students. These animals have a sense that they can affect my behavior toward them by bringing me these objects. They are using their learned behaviors to communicate and affect change in their environment through me.

MODERATE NOVELTY, A MIS-MATCH OF EXPECTATIONS
Or "I've Never Read an Educational Paper Like This One"

Another important and related idea in the field of learning research is that the nervous system responds to novelty of circumstances. Piaget knew this when he proposed his **moderate novelty principle**. If you present a task to an infant or child that is too difficult, she will ignore it. If it is too easy, she ignores it. If the game or task is just slightly different from what a child already knows, she will be intrigued. Children will explore the situation with interest until they have expanded their schemes or stored new information or memories about that event.

The moderate novelty principle has also been called a **mis-match of expectations** by Jan van Dijk (personal seminar notes July 1985). Evidence from scientific studies of the brain show that there is an actual physiological, measurable response when an individual faces a mis-match between his or her expectations and the actual outcome. It is called the P-300 wave (Restak 1979). Some researchers are considering using the P-300 wave as a measure of intelligence that does not require verbal output. Of course, some long term memory functions must be working for someone (infant or adult) to experience the surprise and motivation of novelty.

An example of the mis-match or the moderate novelty principal is one in which a 15 month old infant places small items into a tall container.

You hand him a tube-shaped container with no bottom, which he goes to fill with small objects. When they fall out of the bottom he is surprised, and tries again to put them in, each time inspecting the result with interest. He is expanding his mental schema of container vs. non-container. Another example in even younger infants involves differing responses to familiar vs. unfamiliar people or things, and will be further explained below.

THE ORIENTING RESPONSE OR REFLEX
Or, "I'd Better Pay Attention to This"

The third idea that you need to be aware of is the **orienting response or reflex**. This response occurs when our nervous systems tell us that there is something novel to attend to (Rainsforth 1982). It alerts the senses to the fact that they need to pay attention, so that survival matters and novel things can be dealt with. It results in physiological arousal in preparation for a response of either aversion or attraction. For example, you are driving and hear a loud horn to your left. You immediately turn to attend to decide your further course of action. If the car is about to hit you, you take aversive action. If the car is a Jaguar with a good-looking stranger who's waving, you might be attracted and wave back.

Newborns also have this orienting behavior to stimulation. A person, colorful light, or an object that enters their visual field or alerts them by sound, will cause them to orient toward that person or object so that the memory systems can begin to process and make associations. Whether they can make new associations depends, according to Beverly Rainsforth (1982), on the ability to achieve a **quiet alert state**.

The brainstem has within it a structure which is part of the reticular activating system. This system alerts the rest of the nervous system when there is something to pay attention to, and it is responsible for the orienting reflex. Infants born without cortexes (anencephalic), may orient to a stimulus, but may never learn from the experience. Although many anencephalic infants die shortly after birth, some may live since the brainstem controls breathing, startle responses, waking, sleeping, sucking and crying (Vogel 1988). The reticular formation within the brain stem is responsible for arousal states (sleep, various states of wakefulness, fussiness, crying, and screaming at the top of the lungs).

The orienting response readies the nervous system for further learning. The stimulus that caused the response will then be evaluated as something to which the infant is either attracted or repelled. All living things are either attracted or repelled by events and things in their environments. That's the ultimate bottom line. Jan van Dijk calls this the appetite/aversion system. When you look at your teaching activities, which way have you set up the child's environment? Is it one that attracts, or one that repels? Things that repel will overload the central nervous system, and will generally cause our profoundly involved children to either cry or fall asleep to avoid the

unwanted stimulation. Neurological disorders increase the likelihood that high intensity stimulation of profoundly involved children will result in startles, over-stimulation, and irritability (Rainsforth 1982).

In fact, Rainsforth's research suggests that the evolutionarily older sensory systems (vestibular, cutaneous, gustatory, and olfactory) are more important than the more highly developed visual and auditory systems in stimulating the immature nervous system. Vestibular stimulation is an important factor in maintaining optimal levels of arousal needed for learning.

HABITUATION, Or "That Same Old Dress Again?"

After the child has alerted or oriented to a stimulus, another process comes into play called **habituation**. This means that with repeated exposure to the same situation or object, the child's responses to it decrease. The child has adapted him/herself so that the novelty has worn off, and s/he is ready to move on to other challenges.

Habituation is a process that is very necessary if learning is to occur. It allows all of us to distinguish the familiar from the unfamiliar. Researchers have used the **habituation/ response to novelty paradigm or model** to examine infant memory processes since the 1950's studies begun by Fantz, Fagan and others. This model is the basis for observing visual memory processes in infants. For example, 6 month old infants can hold in memory the facial photo of a stranger for three days. How do they know this? They repeatedly show the infant the stranger A's face, while they measure the amount of time the infant spends gazing at the photo. They present the face over multiple exposures, until it no longer holds much novelty interest for him (the gaze time has decreased). They then pair the A face with a new B face. Immediately the infant fixates for a longer period of time on the new face, with minimal fixation time on the A face. Three days later, the A face is again paired with a new face C. The infant spends a lot of time on the new face C, with little time on face A. This implies previous familiarity with face A.

Habituation, or getting used to a stimulus so that you no longer respond to it as something new, is very important as it allows the nervous system to focus on relevant events, and not be overwhelmed by all the trivial types of stimulation occurring around us all the time. Imagine living in a big city where horns were always honking. If you could not habituate to honking horns, you would flinch or startle each and every time a horn honked. This startling would mean that you could not concentrate on anything for long and new learning would be very difficult.

Habituation is what we want to avoid as we try to keep the romance in an interpersonal relationship. Since we don't want our significant others to habituate to us (become non-responsive), we change ourselves

(the stimulus) by using new fashions, new scents, and by learning, growing, and becoming a new person with each day.

Researchers have found that profoundly involved children may fail to habituate to repeated stimulation or habituate more slowly (Rainsforth). Hence, we see repeated self-stimulatory behaviors in a child who never habituates to (gets his fill of) the stimulus. Self-stimulatory behaviors can interfere with the orienting reflex such that the child shows little interest in the outside world (Van Dijk 1983). This child may not move on to higher levels of learning, but may remain fixated on a narrow range of stimuli. However, the ideas discussed below may have training implications for this child.

THE EMOTIONS--THE GATEWAY TO MEMORY PROCESSING

A fifth and very important area of brain research has to do with the role of the emotions in learning and memory. First, let's look at some examples that apply to us. Do you remember a time when you had a crush on a teacher, so you wanted to do your very best on your homework? Do you still remember the details of some event with your family or friends that was thrilling, exciting, dangerous, surprising, or sad? Do you find yourself remembering tiny details about the scene? Does a sudden smell of a particular aroma or an old song bring back an entire barrage of memories? The reason this is important in the teaching of profoundly involved children is this: there is an emotional relay switch which channels sensory input through deep midbrain structures which make up the limbic system (Alper 1986). These deep structures of the limbic system play a vital role in all memory processes.

Emotional bonding with a caregiver has been shown by many researchers to be critical in the development of infants and young children. In fact, children's healthy curiosity about their environment (seeking out new learning experiences) is directly related to the type of emotional bond and feelings of security they have with their parents (Bretherton 1979)(Ainsworth 1971).

The limbic system has been referred to as the visceral brain, or the emotional brain (Moore 1976). In a word, it's where your gut feelings come from. The cortex of the right hemisphere has a more direct connection with our emotions. The left cortex, on the other hand, with its analytical abilities, serves as a regulator of our emotions. It tries to talk us out of our gut feelings --(no, I really shouldn't throw this computer in the river. I paid too much for it.) Most animals (eg. rats, cats, dogs) have very small cortexes, relying for their memory and communication on their limbic systems. Parts of the limbic system contain structures that are crucial to memory, at least memory of a cognitive (involving recognition and discrimination) as opposed to procedural or habit memory (Mishkin 1987).

Mortimer Miskin, a neuropsychologist, believes that the limbic system is a seat of both emotion and memory, and that emotion serves as a gate

for what is stored (Alper 1986). When you think about it, our moods have a powerful influence over what we remember and how we remember it.

The limbic system is a much older part of the brain (evolutionarily speaking) than is the cortex. This emotional brain is tied in with the brain's newest and the oldest parts. The letters M-O-V-E help us understand its functions (Moore 1976). M--for memory, O--for olfactory, V--for visceral or autonomic functions, E--for emotions. Not all memory is confined in the limbic system, but rather parts of the system seem to contain vital centers through which information must be processed or retrieved so that the entire nervous system can use memory for survival and daily life.

Various structures are part of the limbic system...the hippocampus, the thalamus, hypothalamus, amygdala, and the smell-brain, or rhinencephalon. Taking in of new knowledge can not occur if the hippocampus is removed or destroyed (Adler 1986.) The amygdala is required for integrating visual and tactile memories. Both these are required in declarative or recognition memory (facts, names, places, dates, short term memory discrimination tasks). Without these two structures it is thought that scenes can be perceived but not remembered. Amnesiacs and people with Alzheimer's disease show damage to the hippocampal area (Science News 9-23-89). Recent research is also beginning to show that the amygdala directs the primary emotions in infancy (joy, interest, fear, disgust, anger, sadness) and may evaluate sensory information to decide whether to approach or withdraw from a person, object, or situation (Science News 9-9-89).

The limbic system structures also are vital in communication and language. John Lamendella (1977) points out that the assumptions from research show that while speech is the function of the cortex, it is only the icing on the cake. The underlying non-verbal aspects of communication which make up the bulk of any message involve the emotional limbic system (Lamendella 1977). Jan van Dijk in his work and articles on deaf/blind children also bases his approach to teaching communication on the assumption that learning and communication will not occur unless the child is involved in an emotionally meaningful event. We have also heard about the important role of emotional bonding between infant and mother, and the devastating effects of lack of mothering on the neurological development of a child. Much of that data also comes from animal studies in mother deprivation, as in the famous Harlow's monkey studies.

PROCEDURAL/HABIT MEMORY vs. COGNITIVE/DECLARATIVE MEMORY
Or "You know... it's that thing-a-ma-jig that goes like this."

Miskin (1987) and others have written also about the existence of another memory system (apart from declarative, cognitive or recognition memory) which seems to have different neural pathways. This is perhaps the memory system utilized by some of our profoundly handicapped children. It has been called procedural memory, or habit memory.

Mishkin researched monkeys' ability to learn various kinds of tasks. Some involved having to use recognition of recently seen and rewarded stimuli (ability to keep things in short term memory, and discriminate things already seen). Other tasks involved learning which stimulus contained the hidden reward over many presentations. When the monkeys had the pathways to the limbic structures (the hippocampus and amygdala) cut, they could no longer perform short term recognition memory tasks. However, they could learn through stimulus-response repetition, a non-cognitive, automatic (habit) kind of behavior.

The proposed habit memory system is based on a structure called the striatum in the forebrain, which has direct pathways to the areas controlling movement. The striatum is an evolutionarily ancient part of the brain, older than both the cortex and the limbic system, which explains why even the simplest of animals can learn automatic responses to a stimulus.

The existence of this system may also shed light on why amnesiacs can still perform, using procedural memory, a series of automatically executed motoric behaviors such as how to ride a bike, or how to play a memorized piano piece (Science News, Oct. 1987).

The habit memory system (based on many repetitions of a behavior receiving a tangible reward) may explain why a severely\profoundly handicapped student can find her way to the cafeteria from the classroom, but cannot attach meaning to a variety of objects and gestures involved in communication. Higher cognitive capabilities depend on the short term memory recall, discrimination, and the ability to make quick associations.

Now, what does all of this about orienting reflexes, quiet alert states, habituation, response to novelty, the role of the limbic system and emotions, and a habit memory system have to do with programming approaches for the profoundly handicapped student? Here are the implications as I see them.

IMPLICATIONS FOR TEACHING:
WHAT DO I DO ON MONDAY MORNING?

* Stop the bombardment

-- We must forget about stimulation for the sake of stimulation. Children will not be helped by using "stimulus bombardment" as a teaching technique. Nor do I think it is useful to have as a major goal for a child simply "will tolerate stimulation". We must ask -- stimulation that leads to what? for what? What are we striving for and what will it look like when the child has achieved it? Damaged nervous systems are easily over-stimulated by sensory input, so the

proper amount and kind of stimulation is important. Not only is the type and amount important, but so is how or if a particular stimulus is being used as an anticipatory cue, or pre-cue to an event which is pleasurable for the child.

Occupational therapists can help us in understanding how to get the child's nervous system to achieve a quiet alert state, if indeed it is possible. As Beverley Rainsforth says, it may be easier to achieve the quiet alert state, a precursor to learning, through the older sensory systems (vestibular, touch, taste, and smell) than through vision and hearing. Teachers as caregivers can spend more time with a child using touch and movement to relax and ready the child for learning.

* Give anticipatory cues and wait for a response

-- In teaching, we should look for orienting responses to occur as we give any anticipatory cue i.e. if we present a red checkered bib before each meal, we wait for the child to orient her gaze and/or her touch toward the bib. Orienting responses are usually identified by measuring physiological reactions such as respiration and pulse rate, which would increase to novel or threatening stimulation. Sudden or intense stimulation causes fast heart beat, startle, and defensive responses. Sometimes a child may go to sleep to block out sensory input. If the stimulation is non-threatening and interesting, the pulse rate and respiration decrease fairly quickly. Since we cannot easily measure physiological reactions, we can look for other things like quieting, widening of the eyes, blinking, and visual search and fixation (Rainsforth). Auditory orienting might also include quieting and widening of the eyes.

* Use routine objects/people in daily events

-- We can use situations and objects in our daily routine to attempt to gain the orienting response. We then immediately follow the response with an activity of high interest, basic need, or comfort level, so that responses to the cues of the situation are rewarded, based on the idea of simple associative learning. For example, we show the child the colorful bib and have her touch it, then follow with the activity of eating. After enough exposures we would expect to see some indication of anticipation in body language when we present the bib, such as a lingering gaze and a smile, or a reach toward the bib. Remember that the habit memory system works through repetition and reward, even though the higher cognitive functions (of short-term memory, and quick discrimination) may not be functioning.

-- All things we would want the child to respond to should be real things that are used by, with, or on the child in everyday routines. They should not be isolated from an actual activity, like many testing situations.

Some examples of multi-sensory cues used within a context to promote memory and anticipation are: a consistently worn particular scent by

the caregiver; a bib before eating; holding & hearing a set of keys before a ride in the car; putting shoes on before going outside; caregivers in the classroom wearing a unique colored/patterned apron which the child can come to associate with each different adult; a favorite juice cup of a particular color; a special bath toy always used in the tub, the smell and feel of a bar of soap and a washcloth before bath, a cap placed on the head before going outside. You can think of others using the principle that the cues must be used in the situation itself as part of the activity before they come to elicit anticipation as a pre-cue.

* Design a routine with predictable pleasurable events

-- The daily routine should have its major events be pleasurable, and the events should be part of a stable routine (eating, being held, doing gentle vestibular exercises, getting ready to go outside, getting ready to go home, etc.). With any activity in which we hope for anticipation, and thereby evidence to us that the child has remembered something, we must make sure that the activity has a strong positive emotional appeal for the child. You strive for a situation in which the child likes to be with you as a familiar caregiver. Let's say you have a black and white checkered quilt that you wrap the child in before an activity. If the activity consists of being placed alone on the floor, you will get from the child much less of a reaction or no reaction to the quilt, than if you cuddle the child and rock for a while with soft music or singing. After numerous presentations, look for anticipatory body language when you bring the child into the vicinity of this checkered quilt, as he remembers that the quilt means he will have a wonderful time with you.

* After anticipation, look for preferences/intentional communication

-- If, in the course of the teacher's consistently applied pre-cues, we see the child anticipate events, and show some awareness of the functional use of objects, then primitive communication choice systems can be used. When a child gazes at the preferred item, then at you; or tactually explores two objects and picks the relevant one in the context; or pushes an object toward you; or pulls or pushes your body in a way that says "I want you to do this with me"; then you are beginning to move into the realm of intentional communication. As I mentioned earlier, many of our pets are quite good at intentional communication. We can certainly learn something from them.

-- Body games or bouncy games are mini-routines in which a position or a movement is the child's cue that the fun will begin. When you pause within this game routine, you wait for the child to signal you with a movement in some way that he wants more of the motion.

*** After anticipation is achieved, toss in a discrepancy to test awareness and communication**

-- If a child seems to be remembering routine events from consistent contextual clues preceding an emotionally meaningful event, the teacher can slightly alter one of the clues to see if the novelty, or the mismatch between the child's expectation and the outcome, attracts the child's attention (Van Dijk 1983). This check on awareness works only within the context of a stable routine. For example, the child is routinely expecting to see you show up with her red bib before meal time, but instead you put in front of her a hairbrush, and leave the bib off to the side a bit, will she realize that there is a problem, and orient toward the bib to let you know she is aware of the discrepant situation? At an even higher level, will she then look at you as if to ask "what's going on here? Have you lost your mind?"

CONCLUSION

You can be creative as a teacher. You and your team must be willing to experiment with some ideas and see if they work for your profoundly involved students. I have discussed the ideas that have been most helpful to me and others in setting up a learning environment for these children. Within a safe, predictable routine, and using multi-sensory pre-cuing of emotionally rewarding activities with caregivers, we set the stage for seeing the development of memory and anticipation. Once we have this, we may see in the children the development of preferential orienting when given a choice. Ultimately, we want stimulus preferences to lead to voluntary or conscious communication with us. While it is not possible for children in coma-like states to function on a voluntary movement basis, others who show some response to their surroundings may benefit from your application of these principles.

We all strive as teachers to provide the settings in which severely/profoundly handicapped children can make the most of their cognitive potential. If this paper has been of help to you in guiding your thinking and recommendations on educational programming, my purpose will have been fulfilled.

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REFERENCES

Ainsworth, Mary; Sylvia Bell, and Donelda Stayton. 1971. Individual differences in strange situation behavior of one-year-olds. The Origins of Human Social Relations, H.R. Schaffer, ed., Academic Press, New York, pp. 17-51.

Alkon, Daniel. July 1989. Memory storage and neural systems. Scientific American.

Alper, Joseph. July/August 1986. Our dual memory. Science 86, 44-49.

Bretherton, I., Bates, E., Benigni, L., et. al. 1979. Relationships between cognition, communication, and quality of attachment, in Bates, E., The emergence of symbols, Academic Press, New York.

Hooper, Judith and Dick Teresi. 1986. The Three Pound Universe. Dell Publishing, New York. p 185-217.

Hubel, David H. 1988. Eye, Brain, and Vision, Scientific American Library, W.H. Freeman and Co., New York.

Lamendella, John. T. 1977. The limbic system in human communication. In Whitaker and Whitaker, Studies in Neurolinguistics, Academic Press, New York.

Mishkin, Mortimer and Tim Appenzeller. 1987. The Anatomy of Memory, Scientific American Reprint.

Moore, Josephine C., Jan. 1976. Behavior, bias, and the limbic system. American Journal of Occupational Therapy. Vol.30, no.1, 11-19.

Rainsforth, Beverly. 1982. Biobehavioral state and orienting: Implications for educating profoundly retarded students. TASH Journal,vol.6, winter, 33-37.

Restak, Richard M., M.D. 1979, The brain: the last frontier. Warner Books, New York.

Sacks, Oliver. 1987. The man who mistook his wife for a hat. Harper and Row, New York.

Science News -- Oct. 31, 1987; Vol. 132. Piano playing preserved in dementia.

---------- ibid. Dissecting learning in Aplysia.

---------- Sept. 9, 1989: Vol. 136. Seeking the source of emotions.

---------- Sept. 23, 1989; Vol. 136. The anatomy of me loss.

---------- Nov. 28, 1987; Vol. 132. New connections ma memorable.

Wilson Quarterly, Autumn 1985. Science and Technology--Educ Snails. p.29.

Van Dijk, Jan. 1983. Rubella Handicapped Children, 2nd Ed. and Zeitlinder B.V.; Lisse - The Netherlands. p. 177.

Vogel, Shawna. April 1988. Discover Magazine. Anencephalic